NAWMP: Some Thoughts on Coherence and Integration

At the risk of oversimplification, we can probably categorize most decisions of waterfowl managers as falling into the categories of harvest (e.g., the setting of hunting regulations), habitat (e.g., the procurement and management of wetland habitat), and soliciting human support (e.g., advertising programs developed to recruit new hunters or persons with conservation interests). These classes of decisions take different forms at different spatial scales, and we might classify these scales as national/international, regional (flyways, joint ventures), state/province, and local. We can also classify objectives of the waterfowl management programs that make these decisions into 3 broad categories: those concerning waterfowl populations, those concerning habitat itself (regardless of habitat influences on waterfowl), and those involving user groups (e.g., hunters, bird-watchers). The terms "coherence" and "integration" convey the basic idea that neither these categories of decisions, nor the scales at which they occur, nor the classes of objectives to which they are directed are independent, and that decision processes that formally recognize these dependencies are likely to be more effective than programs that treat the various decisions as independent (e.g., see Runge et al. 2006).

Even if there is agreement within the waterfowl community on this basic meaning, there is certainly disagreement on just how we might attain a coherent and integrated approach to waterfowl management. One view appears to favor a top-down approach in which every management decision directed at any of these 3 waterfowl program objectives made at every scale is the purview of a single governing body. This governing body would specify a single set of objectives that would include all 3 listed classes, with the appropriate weights or constraints to deal with them all simultaneously. Allocation of resources to different management actions that differentially influence the different objectives would be handled as a single optimization problem. The advantage of such an approach is the potential for complete integration of management across these multiple actions, scales and objectives. Problems with this approach are the requirements of (1) added complexity in modeling and optimization, and, most important, (2) a single institutional framework for waterfowl management that would assume responsibility for decisions now made by various organizations at the various spatial scales.

An alternative and seemingly more pragmatic view is that increased coherence and integration can be achieved via an approach that permits maintenance of existing institutional decision frameworks and requires smaller increases in complexity. This approach would recognize that the relative value of integration varies across decision classes and scales, to the extent that every decision need not include all 3 objective classes or require simultaneous consideration of all possible decision classes and scales in the optimization. Instead, some decisions might focus on only one or two classes of objectives and could be made conditional on other decisions having been made.

As an example of what this alternative (to a unified governing body) approach to achieving increased integration might look like, consider the decision diagram provided by Mike Anderson. As above, Mike noted that decisions can involve hunting regulations, habitat procurement or management, or solicitation of human support (3 columns of Mike's diagram) at each of the following scales, international/national, regional, state/provincial, and local (rows of Mike's diagram). Missing from the

diagram are the 3 classes of objectives to which the various decisions are directed, but we can keep these in mind when considering the different possible decisions. With a view to this diagram it is possible to consider examples of how we might try to increase integration (1) across spatial scales within a decision class, (2) among objectives within a decision class, and (3) among decision classes. We will try to illustrate these 3 forms of integration using the example of decisions about hunting regulations.

Current harvest management includes annual decisions at the national/international level that entail selection of a set of regulations packages that specify daily bag limit and season length for each of the 4 flyways. Annual decisions at the state level might involve geographic zones and temporal season splits that occur within the limits imposed by the federal-level decision. Annual decisions at the local level might involve how many hunters to allow on a public hunting area, for example, and sometimes even specified hunting stations or locations. These decisions are linked, in that decisions at smaller spatial scales are always conditional on decisions made at larger scales (e.g., a state cannot propose season splits that lead to a greater season length that that specified at the flyway level). In addition to these linkages among the decisions themselves, the outcomes of the decisions, for example continental harvest rates, are a product of all of these decisions made at the different scales.

In addition to these mechanistic linkages among the harvest decisions at different spatial scales, these decisions are also linked in that they influence some of the same classes of objectives. All of these harvest decisions influence duck harvest, and are thus relevant to objectives for duck populations. All of these harvest decisions have the potential to influence the "people" objective of support from at least one user-group (hunters). I would argue that these harvest decisions do not influence habitat directly, although indirect influence through effects on support of user-groups is likely.

Finally, decisions made at all scales for waterfowl habitat management and solicitation of human support for waterfowl programs affect the results of harvest decisions. For example, habitat is very relevant to continental harvest rate in influencing overall duck numbers through effects on reproductive rate and survival rate, and to state and local area harvest, because of influence on local distribution and abundance of birds. Thus, although harvest decisions do not influence habitat directly, the results of harvest decisions (in terms of numbers and rates of harvest) are very much influenced by, and thus conditional on, the objectives and effectiveness of habitat management. Similarly, numbers of duck hunters are influenced by decisions focused on increasing human support. Numbers of hunters clearly influence waterfowl harvest rates and numbers, important results of harvest decisions.

Thus we would claim that dependencies exist among different harvest decisions made at different spatial scales in terms of both implementation and results, among the objectives influenced by harvest decisions made at different spatial scales, and between harvest decisions and the other major classes of decision, habitat management and solicitation of human support. Despite this potentially complex list of dependencies associated with harvest decisions, we believe that it is possible to exploit the variation in magnitude and importance of these dependencies in order to deal with integration in a useful and pragmatic manner. For example, consider the dependencies among harvest decisions at the various spatial scales. Under the current approach to AHM, the selection of the appropriate regulations package is the primary harvest decision that affects harvest rate, and hence, population size. State and local level

decisions are not ignored, but are rather included as sources of variation in the actual harvest rate that results from a particular set of continental/regional hunting regulations. Thus, rather than attempt to somehow integrate or sum up the various effects occurring at all local and state levels to develop a continental harvest rate, our approach is to view these effects as sources of variation that must be incorporated into predictions.

As noted above, the other objective thought to be influenced directly by harvest decisions is the development of human support for waterfowl management programs. An important support group is waterfowl hunters, and it is becoming widely recognized that we must do a better job of including effects on hunter participation when setting hunting regulations. This suggests that we begin to incorporate into our management models the consequences of various harvest decisions not only for waterfowl harvest rate, but also for retention and recruitment of waterfowl hunters. Daily bag limits and season lengths (national/regional decisions) may be important, but state and local decisions may be even more important. So in this situation, we may not want to treat the effects of these smaller scale decisions as random variation because of their hypothesized importance to this objective. If these are really the major determinants of hunter participation, then it would be wise to develop models that link local hunter activity to such decisions, and to value this objective of hunter participation quite highly (relative to objectives involving duck numbers) in the objective function (a formal statement of objectives that forms the basis for optimization) for these state and local decisions. So we can envision state and local harvest decisions being made conditional on national/flyway decisions and focusing primarily on the objectives of hunter participation and satisfaction. Decisions at the national/regional level could either ignore the explicit objective of hunter participation (assuming that it is being dealt with already by trying to maximize harvest, a quantity related to hunter participation and satisfaction) or else include it as an explicit objective (a new state variable such as hunter numbers would likely have to be added to the objective function), but not weight it as heavily as harvest and population objectives in the overall objective function.

The final set of dependencies to be considered is that among the various classes of decisions, harvest, habitat, and human. Consider the importance of habitat to the results of harvest decisions. Assuming that waterfowl survival and reproductive rates depend on habitat on breeding, migration and wintering habitat, then numbers of birds harvested for any set of hunting regulations will depend on amount and quality of existing habitat. This kind of dependency is already considered in the mid-continent AHM modeling, for example, with May ponds being a key environmental variable that determines reproductive rate. We can either continue this approach of treating pond numbers as an important covariate that can be estimated in the spring of each year and projected forward as a random variable arising from a stationary process (i.e., although the number of ponds in any year is a random variable, the distribution of this random variable is assumed to be the same from year to year), or we can model projected changes in pond numbers as a function of habitat management decisions and long-term strategies. The latter approach would require some additional effort but would go a step toward increased integration. A unified approach to integration might include habitat and harvest decisions in a single optimization framework, and the suggestion here is simply that current and possible new

approaches achieve some degree of integration despite stopping short of full integration of decision processes.

In summary, the focus of the paper by Runge et al. (2006) and subsequent discussions by the waterfowl community on coherence and integration is important. Various linkages and dependencies exist among decisions, scales at which they are made, and objectives, and these linkages should be recognized and incorporated into the decision-making process. One approach to achieving complete integration would be establishment of a single institution charged with making all decisions relevant to waterfowl management. The primary purpose of the current document is to suggest that some strides towards increased integration and coherence can be made within the present institutional framework. The first step in increasing integration is to recognize the linkages (1) among decisions made across spatial scales within a decision class, (2) among objectives within a decision class, and (3) among decision classes. The degree to which linkages are treated explicitly (e.g., incorporated directly into models and/or optimization) versus implicitly (e.g., as when specific outcomes of decisions at one scale are treated as additional variation in the predicted distributions of outcomes at a different scale) in the decision process will then depend on the relative importance of a decision to the focal objective(s). Regardless of whether the waterfowl community chooses to try to move towards a single governing institution, we believe that increased integration is possible now within existing institutional frameworks.

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